

E4M0060075K1

Silicon Carbide Power MOSFET
E-Series Automotive
N-Channel Enhancement Mode



Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Qrr)
- Halogen free, RoHS compliant
- Automotive Qualified (AEC-Q101) and PPAP Capable

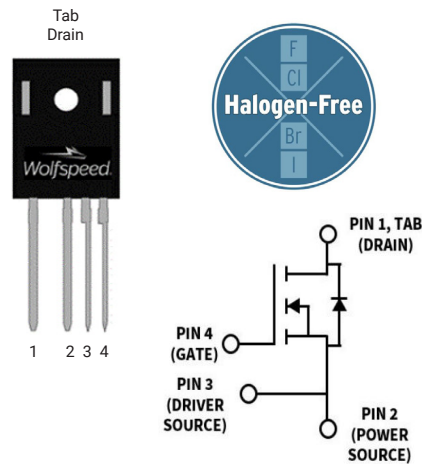
Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Typical Applications

- Motor Control
- EV Battery Chargers
- High Voltage DC/DC Converters

Package



Part Number	Package	Marking
E4M0060075K1	TO-247-4L	E4M0060075K1

Maximum Ratings ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Note
V_{DSmax}	Drain - Source Voltage	750	V	
V_{GSmax}	Gate - Source Voltage	-8/+19	V	Note: 1
I_D	Continuous Drain Current, $V_{GS} = 15\text{ V}$	$T_c = 25^\circ\text{C}$	33	A Fig. 19 Note: 2
		$T_c = 100^\circ\text{C}$	24	
$I_{D(pulse)}$	Pulsed Drain Current, Pulse width t_p limited by T_{jmax}	101	A	Fig. 22
P_D	Power Dissipation, $T_c=25^\circ\text{C}$, $T_j = 175^\circ\text{C}$	126	W	Fig. 20 Note: 2
T_j, T_{stg}	Operating Junction and Storage Temperature	-55 to +175	$^\circ\text{C}$	
T_L	Solder Temperature, 1.6mm (0.063") from case for 10s	260	$^\circ\text{C}$	
M_d	Mounting Torque , M3 or 6-32 screw	1	Nm	
		8.8	lbf-in	

Note (1): Recommended turn off / turn on gate voltage $V_{GSop} - 4V...0V / +15V$

Note (2): Verified by design


Electrical Characteristics ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	750			V	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.3	3.8	V	$V_{DS} = V_{GS}, I_D = 3.67\text{ mA}$	Fig. 11
			1.9		V	$V_{DS} = V_{GS}, I_D = 3.67\text{ mA}, T_J = 175^\circ\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	μA	$V_{DS} = 750\text{ V}, V_{GS} = 0\text{ V}$	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		60	78	m Ω	$V_{GS} = 15\text{ V}, I_D = 13.4\text{ A}$	Fig. 4, 5, 6
			97			$V_{GS} = 15\text{ V}, I_D = 13.4\text{ A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		10		S	$V_{DS} = 20\text{ V}, I_{DS} = 13.4\text{ A}$	Fig. 7
			8			$V_{DS} = 20\text{ V}, I_{DS} = 13.4\text{ A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		1203		pF	$V_{GS} = 0\text{ V}, V_{DS} = 500\text{ V}$ $f = 100\text{ kHz}$ $V_{AC} = 25\text{ mV}$	Fig. 17, 18
C_{oss}	Output Capacitance		69				
C_{rss}	Reverse Transfer Capacitance		7				
E_{oss}	C_{oss} Stored Energy		10		μJ	$V_{DS} = 500\text{ V}, f = 100\text{ kHz}$	Fig. 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		90		pF	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }500\text{ V}$	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		129		pF		
E_{ON}	Turn-On Switching Energy (External Diode)		57		μJ	$V_{DS} = 500\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 13.4\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 135\text{ }\mu\text{H}, T_J = 25^\circ\text{C}$ FWD = External SiC Diode	Fig. 25, 27
E_{OFF}	Turn-Off Switching Energy (External Diode)		13				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		55		μJ	$V_{DS} = 500\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 13.4\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 135\text{ }\mu\text{H}, T_J = 25^\circ\text{C}$ FWD = Internal Body Diode	Fig. 25, 27
E_{OFF}	Turn-Off Switching Energy (Body Diode FWD)		17				
$t_{d(on)}$	Turn-On Delay Time		8		ns	$V_{DD} = 500\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 13.4\text{ A},$ $R_{G(ext)} = 2.5\text{ }\Omega, L = 135\text{ }\mu\text{H}, T_J = 25^\circ\text{C}$ Timing relative to V_{DS} Inductive load	Fig. 26, 27
t_r	Rise Time		9				
$t_{d(off)}$	Turn-Off Delay Time		16				
t_f	Fall Time		9				
$R_{G(int)}$	Internal Gate Resistance		3.0		Ω	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
Q_{gs}	Gate to Source Charge		14		nC	$V_{DS} = 500\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 13.4\text{ A}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		18				
Q_g	Total Gate Charge		52				

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as C_{oss} while V_{ds} is rising from 0 to 500V
 $C_{o(tr)}$, a lumped capacitance that gives same charging time as C_{oss} while V_{ds} is rising from 0 to 500V


Reverse Diode Characteristics ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.8		V	$V_{GS} = -4\text{ V}, I_{SD} = 6.7\text{ A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.2		V	$V_{GS} = -4\text{ V}, I_{SD} = 6.7\text{ A}, T_J = 175^\circ\text{C}$	
I_S	Continuous Diode Forward Current		20	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	
$I_{S, \text{pulse}}$	Diode pulse Current		101	A	$V_{GS} = -4\text{ V}$, pulse width t_p limited by T_{Jmax}	
t_{rr}	Reverse Recover time	12		ns	$V_{GS} = -4\text{ V}, I_{SD} = 13.4\text{ A}, V_R = 500\text{ V}$ $di_F/dt = 6101\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	244		nC		
I_{rrm}	Peak Reverse Recovery Current	35		A		
t_{rr}	Reverse Recover time	20		ns	$V_{GS} = -4\text{ V}, I_{SD} = 13.4\text{ A}, V_R = 500\text{ V}$ $di_F/dt = 2395\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$	
Q_{rr}	Reverse Recovery Charge	178		nC		
I_{rrm}	Peak Reverse Recovery Current	16		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.91	1.19	$^\circ\text{C}/\text{W}$		Fig. 21



Typical Performance

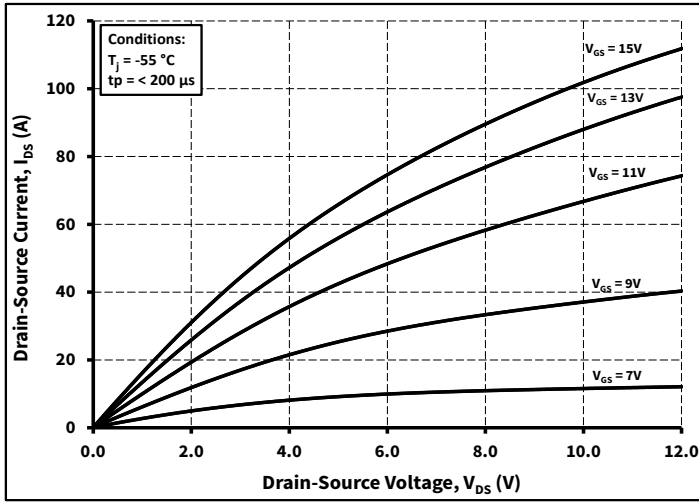
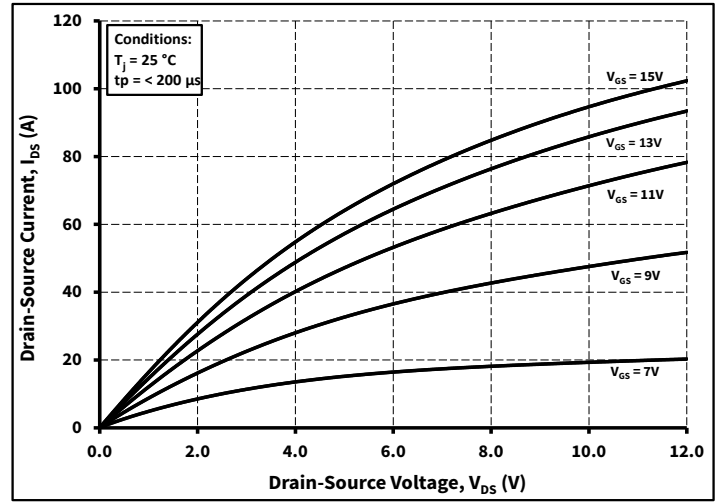
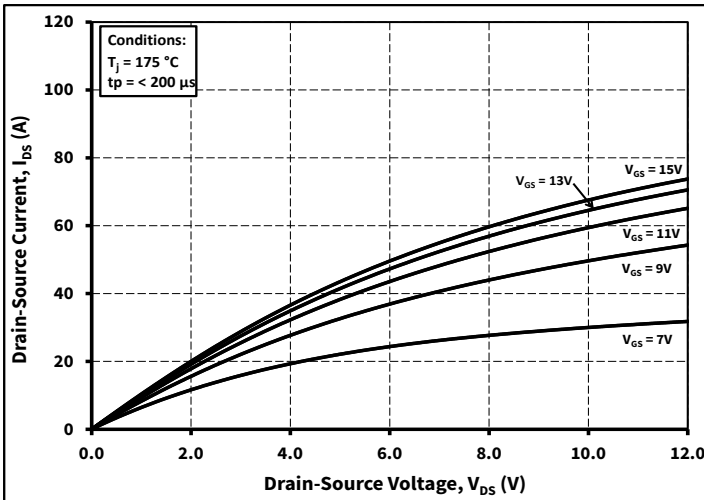
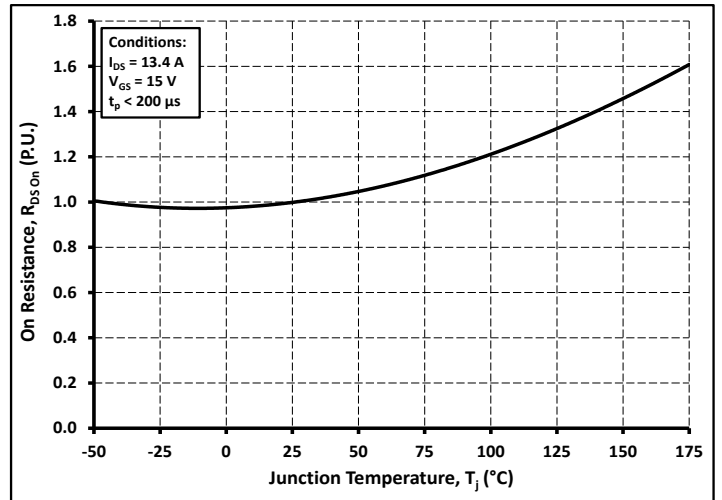
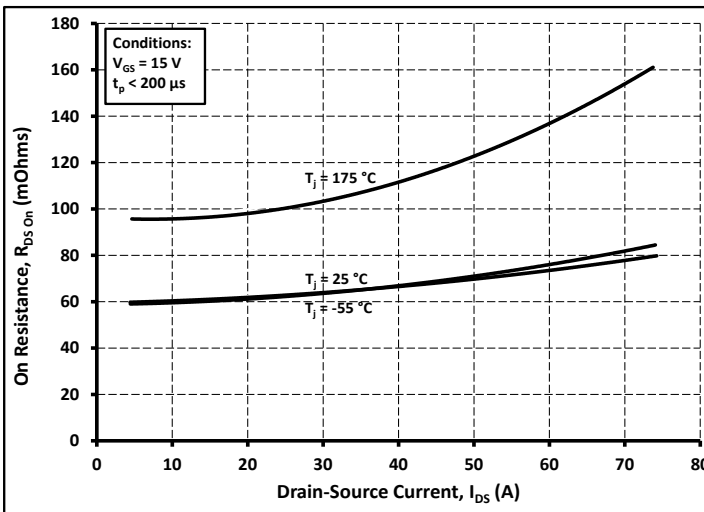
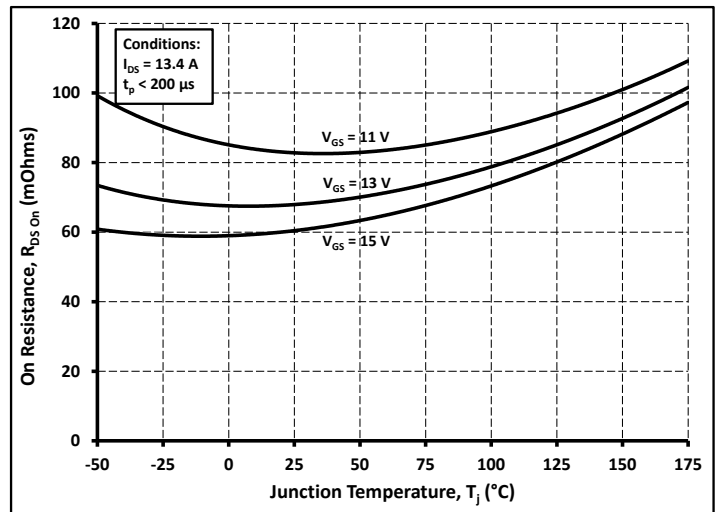
Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$ Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$ Figure 3. Output Characteristics $T_J = 175\text{ }^{\circ}\text{C}$ 

Figure 4. Normalized On-Resistance vs. Temperature

Figure 5. On-Resistance vs. Drain Current
For Various TemperaturesFigure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

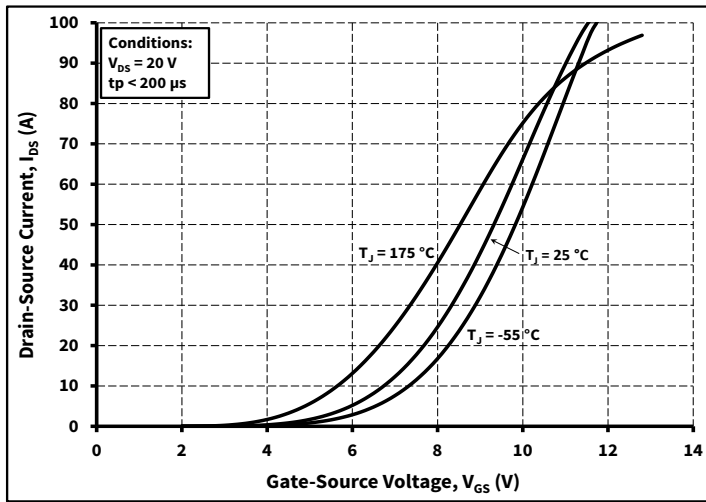


Figure 7. Transfer Characteristic for Various Junction Temperatures

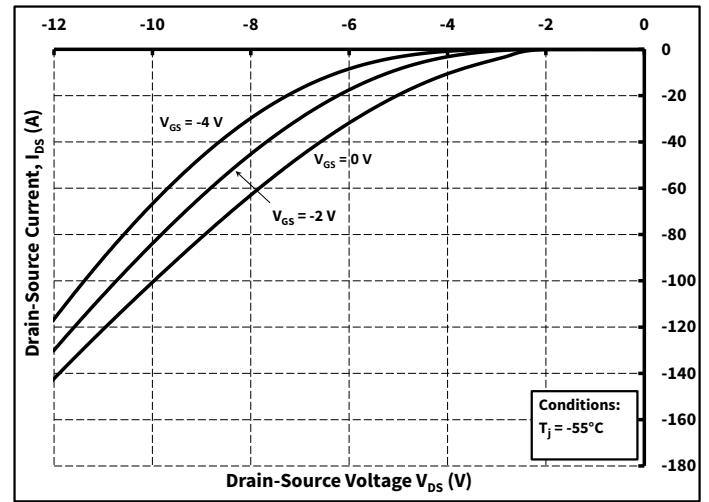


Figure 8. Body Diode Characteristic at -55°C

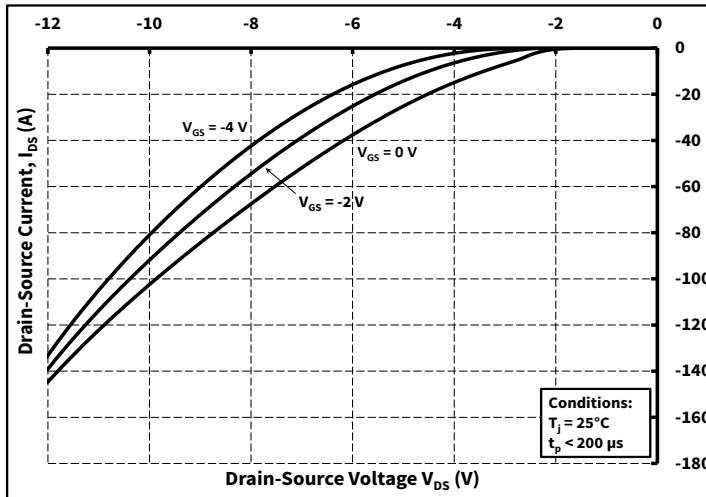


Figure 9. Body Diode Characteristic at 25°C

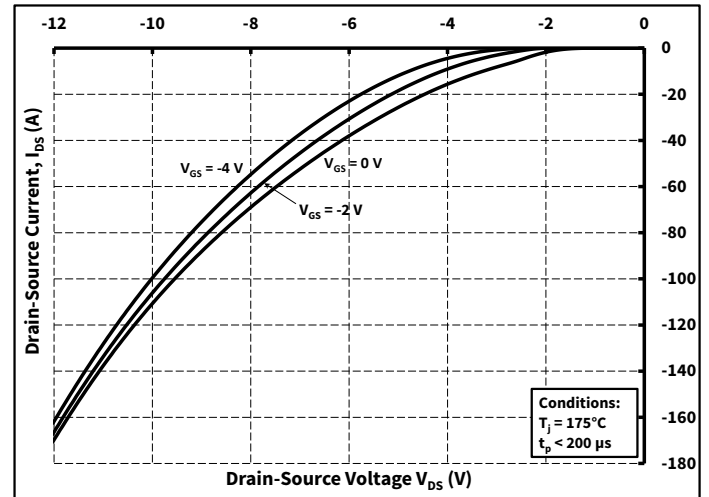


Figure 10. Body Diode Characteristic at 175°C

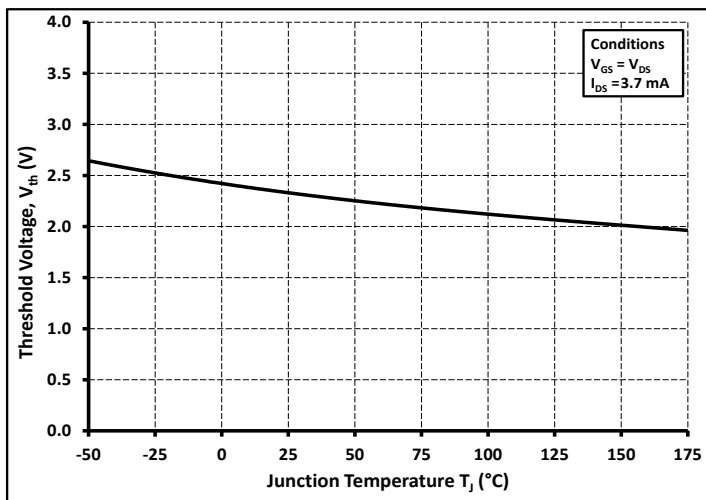


Figure 11. Threshold Voltage vs. Temperature

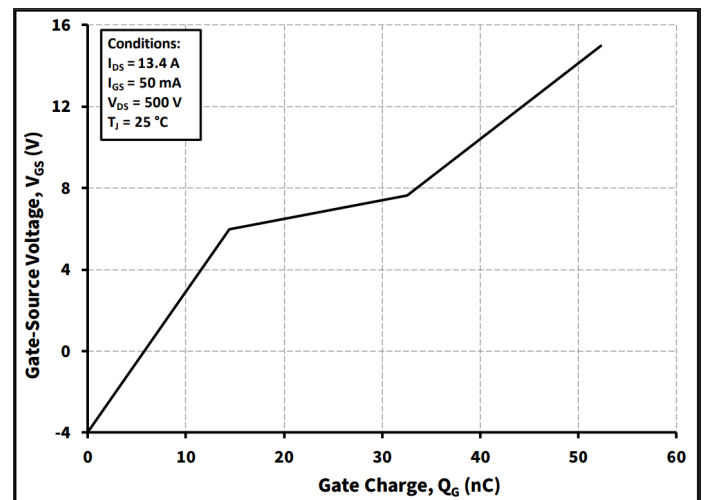


Figure 12. Gate Charge Characteristics

Typical Performance

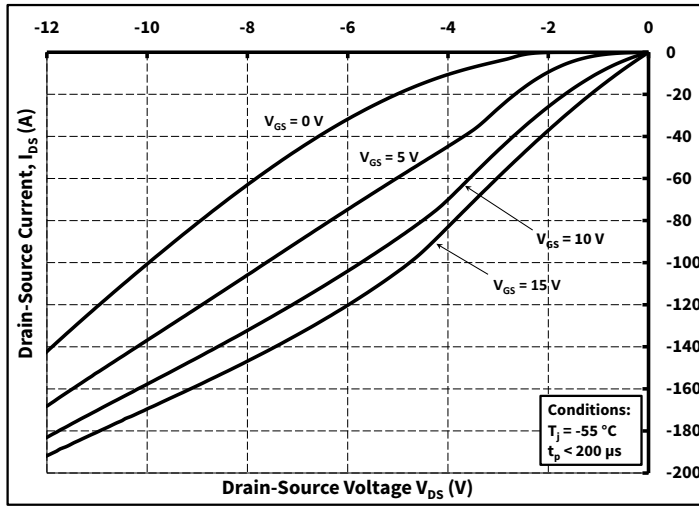
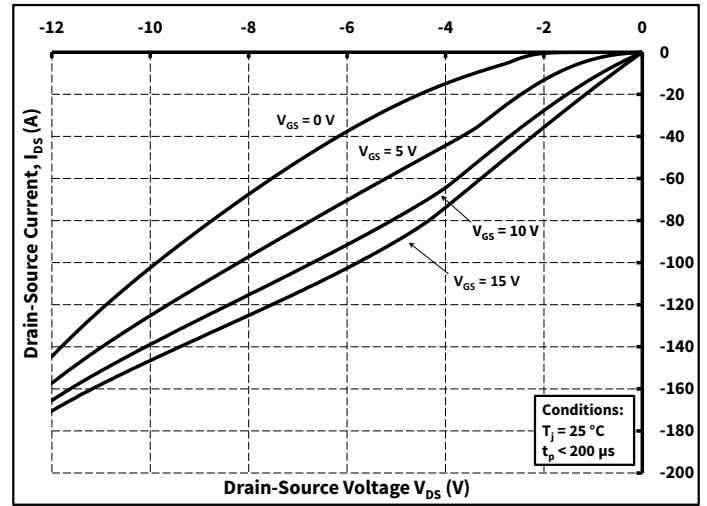
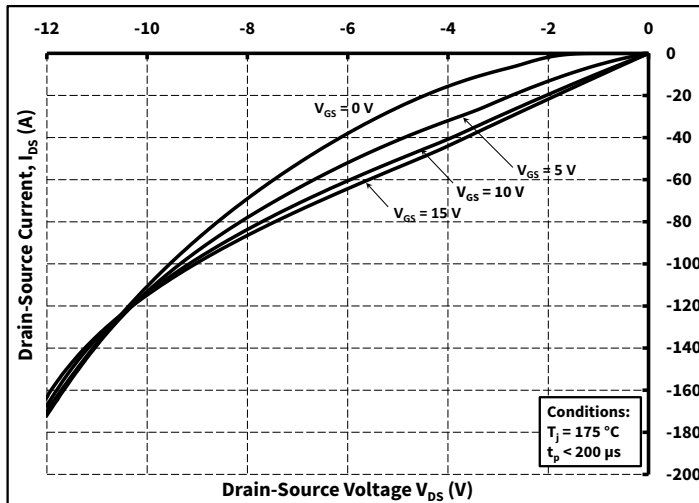
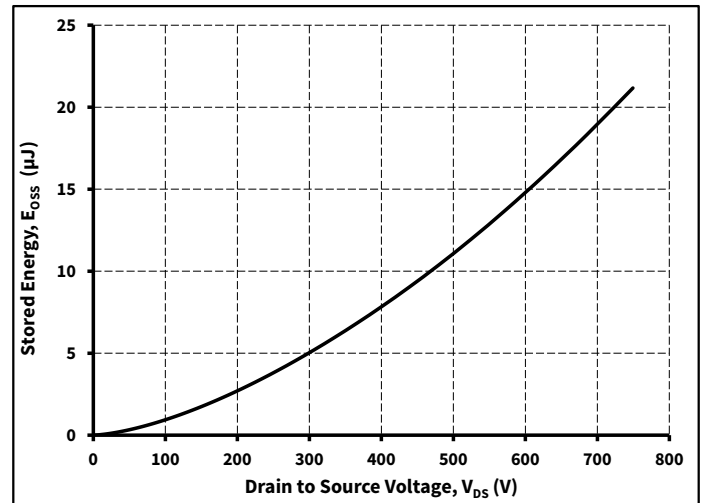
Figure 13. 3rd Quadrant Characteristic at $-55\text{ }^{\circ}\text{C}$ Figure 14. 3rd Quadrant Characteristic at $25\text{ }^{\circ}\text{C}$ Figure 15. 3rd Quadrant Characteristic at $175\text{ }^{\circ}\text{C}$ 

Figure 16. Output Capacitor Stored Energy

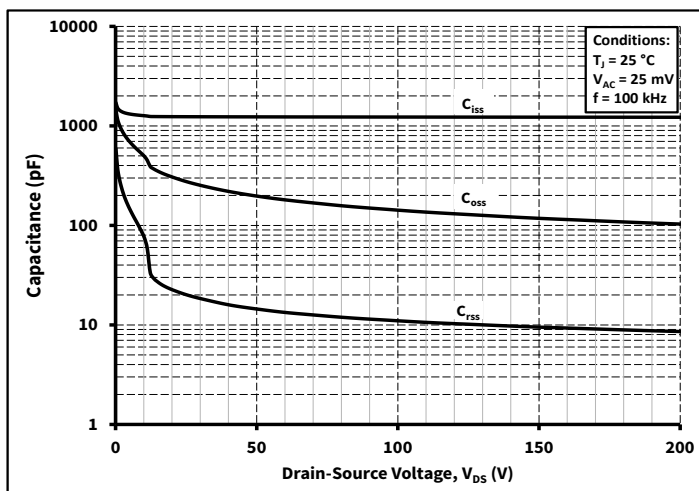


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

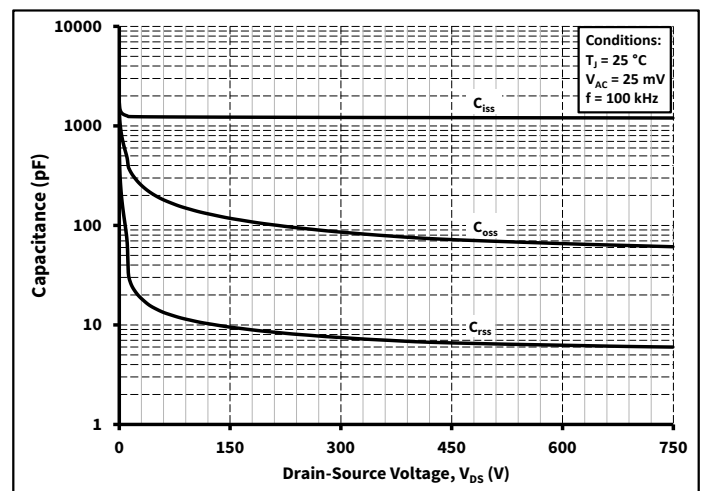


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 750V)

Typical Performance

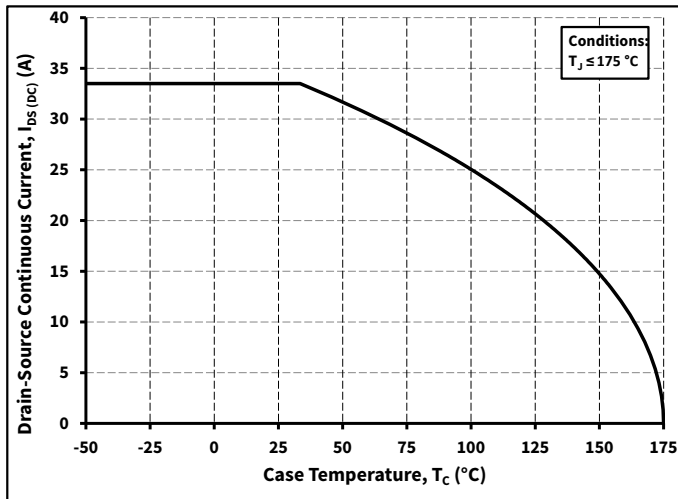


Figure 19. Continuous Drain Current Derating vs. Case Temperature

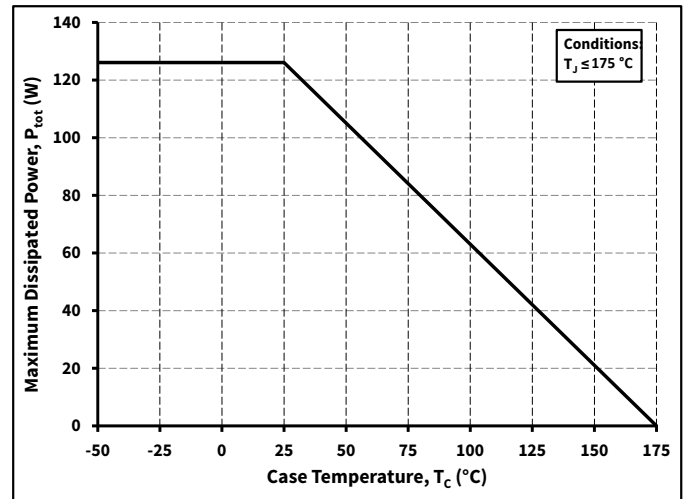


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

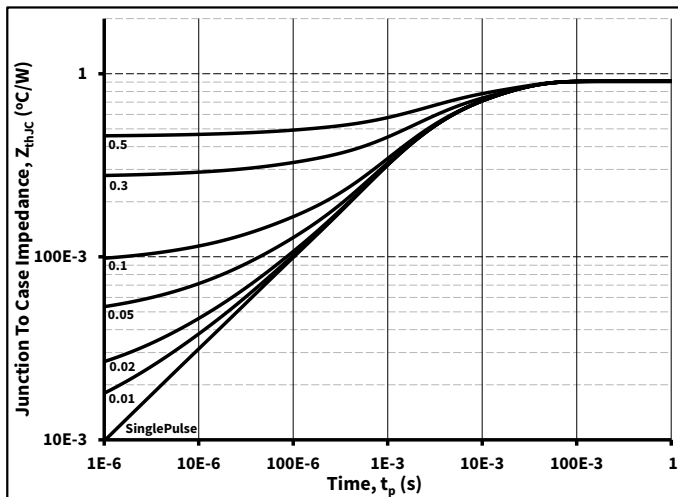


Figure 21. Transient Thermal Impedance (Junction - Case)

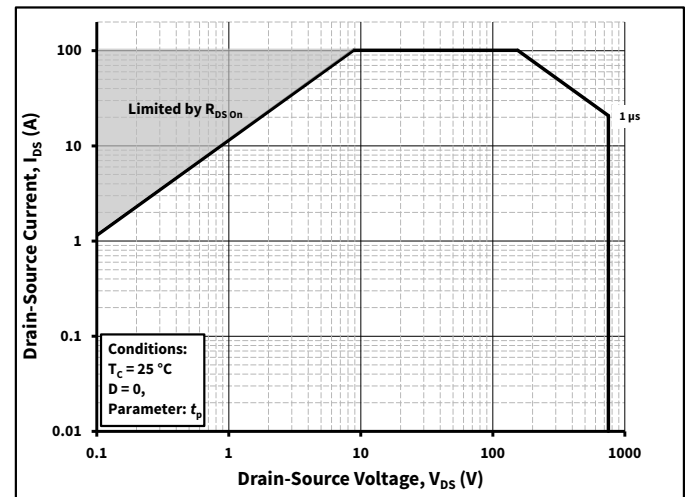
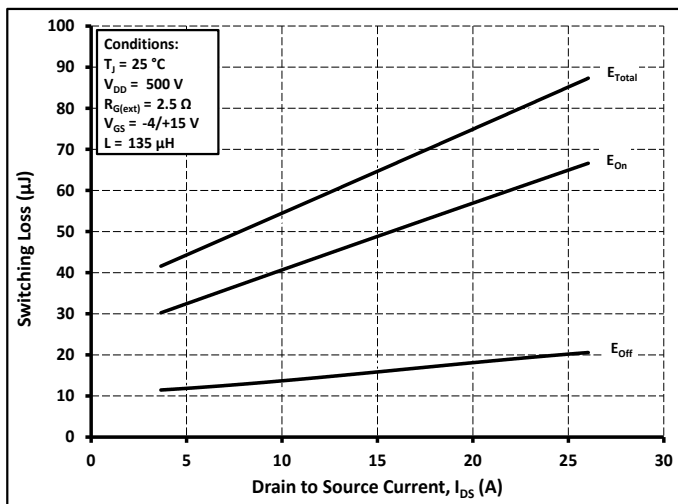
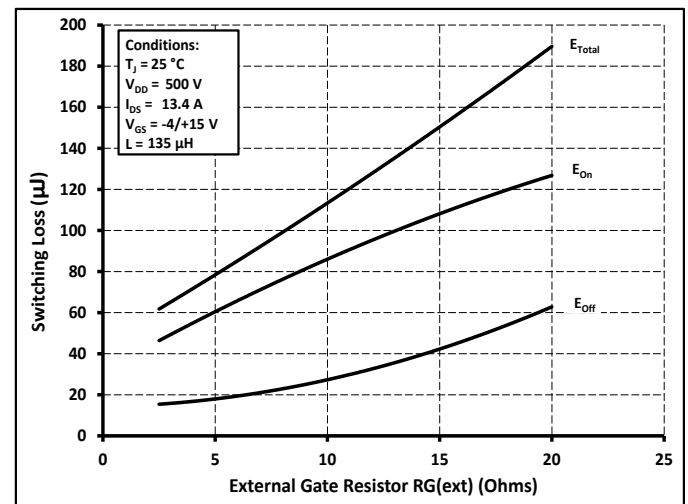


Figure 22. Safe Operating Area

Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 500V$)Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

Typical Performance

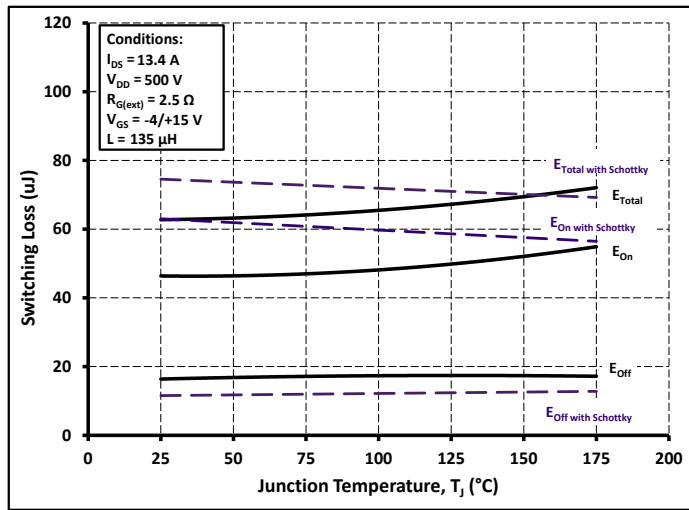


Figure 25. Clamped Inductive Switching Energy vs. Temperature

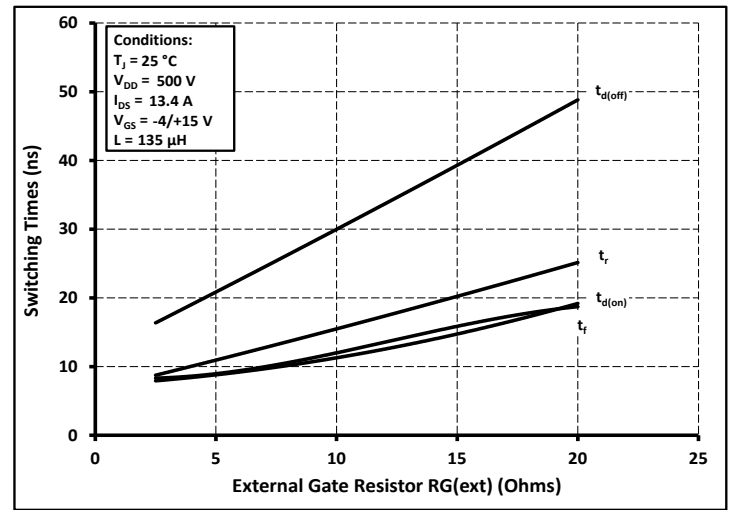


Figure 26. Switching Times vs. $R_{G(ext)}$

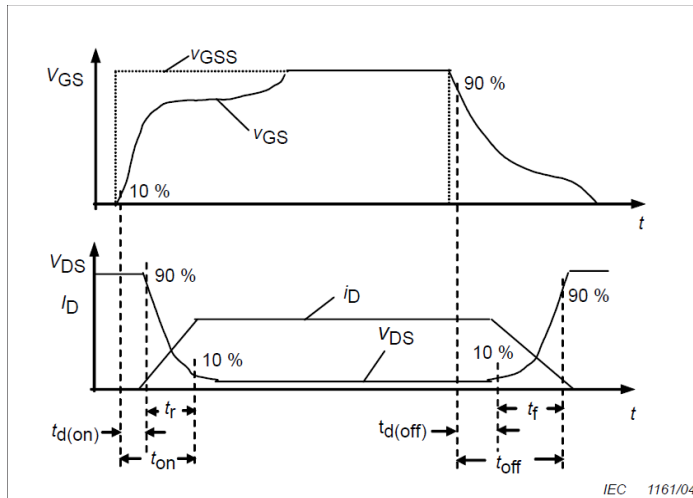


Figure 27. Switching Times Definition

Test Circuit Schematic

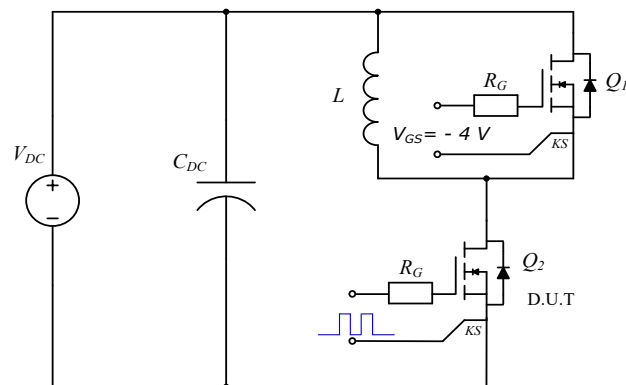
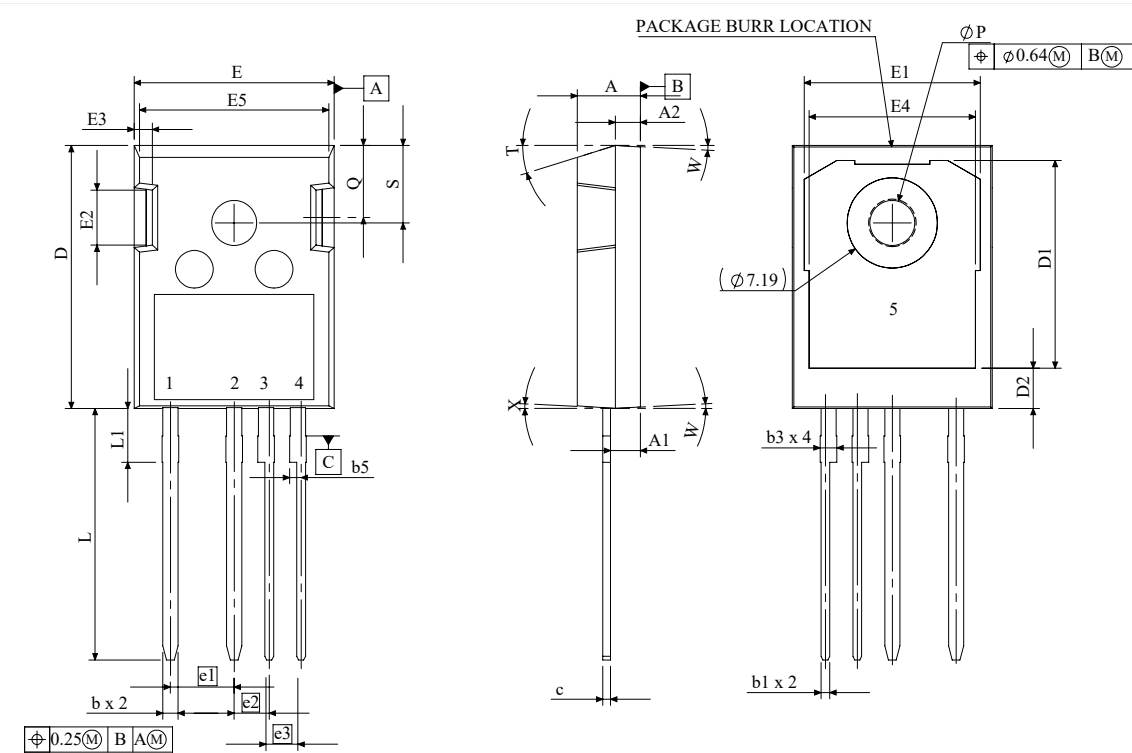


Figure 28. Clamped Inductive Switching Waveform Test Circuit

Package Dimensions



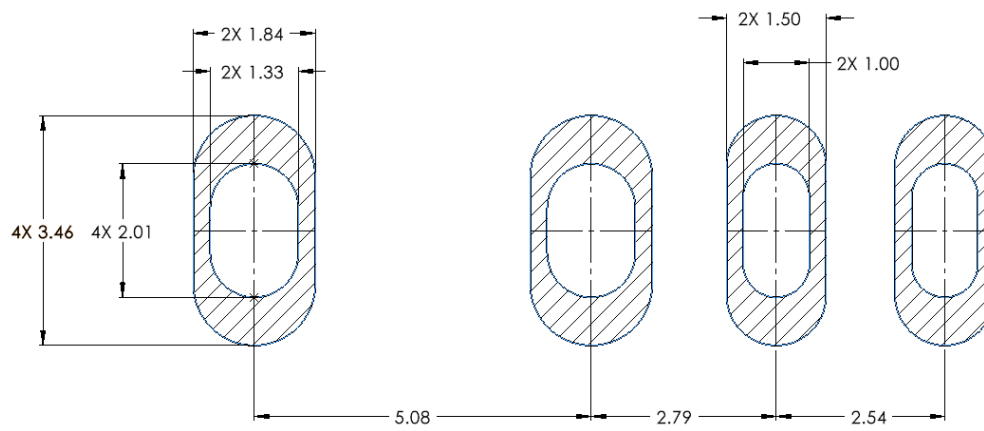
SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.22	2.6
A2	1.91	2.16
b	1.10	1.30
b1	0.65	0.79
b3	1.34	1.44
b5	0.74	1.14
c	0.55	0.68
D	20.76	21.14
D1	16.25	17.65
D2	2.95	3.35
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e1	5.08 BSC	
e2	2.79 BSC	
e3	2.54 BSC	
L	19.72	20.32
L1	3.87	4.47
ϕP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

1	DRAIN
2	SOURCE
3	DRIVER SOURCE
4	GATE
5	DRAIN

- NOTE:
1. ALL METAL SURFACES ARE TIN PLATED (MATTE), EXCEPT AREA OF CUT.
 2. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
 3. ALL DIMENSIONS ARE LISTED IN MILLIMETERS. ANGLES ARE IN DEGREES.
 4. BURR OR MOLD FLASH SIZE (0.5 mm) IS NOT INCLUDED IN THE DIMENSIONS

**Recommended Solder Pad Layout**

All dimensions in mm



Revision history

Document Version	Date of release	Description of changes
1.0	March 2024	Initial release
2	January - 2025	Legal Disclaimer Updated
3	December - 2025	Updated datasheet values for: • Continuous Drain Current • Threshold Voltage • Drain-Source On-State Resistance • Turn-On and Turn-Off Switching Energies • Continuous Diode Forward Current • Reverse Recovery Charge, Current, and Time • Updated Datasheet Figures • Removed Figure: Clamped Inductive Switching Energy vs. Low Drain Current



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